Research FOR FARMERS

SUMMER—1961

CANADA DEPARTMENT OF AGRICULTURE

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Ottawa, Ontario

HON. ALVIN HAMILTON, *Minister*
S. C. BARRY, *Deputy Minister*

NOTES AND COMMENTS

A falling off in per capita consumption of potatoes has long been a matter of concern to producers. Consumers are inclined to lay the blame on the poor quality of the product being offered. It is popularly supposed that good cooking quality in potatoes is associated with high dry-matter content and plant breeders have sought to develop varieties that excelled in this respect. Recent evidence suggests that this is not always the case and that there must be other factors involved in good quality. Tests at Fredericton showed that last year's crop in Eastern Canada was unusually high in dry matter. But cooking scores were disappointing because of excessive sloughing during boiling. In these tests, 21 seedlings that averaged 25.7 per cent dry matter scored 80.5 points boiled and 85.4 baked. Another 21 seedlings having an average of 22.9 per cent dry matter gave scores of 87.3 boiled and 86.8 baked. A score of 85 points in either category indicates good table quality. These results show that a high content of dry matter does not necessarily result in the best eating quality in the cooked potato.

* * *

Another aspect of potato breeding at Fredericton deals with a different problem. It involves the use of germ plasm from wild species of Solanum to establish resistance to the late blight fungus. A dozen or more species native to the mountains of Mexico may hold the means of countering this most serious malady. The job of transferring the qualities of blight resistance from otherwise useless species to commercial varieties is not easy. As is the case with wheat rust, the potato blight fungus is not a single entity, but exists as many races differing in their ability to attack the potato plant. A variety resistant to one race may succumb to another. But thanks to the discovery of these resistant wild species, plant breeders are more hopeful of solving the problem. In his article on page 4 Dr. Graham tells of this interesting facet of the potato breeding program and of the rigorous tests given to determine the resistant qualities of promising seedlings.

* * *

In these days of wonder drugs and new pesticides effective against most animal enemies, it comes as a surprise to find an exception to the general rule. Although little known in Canada until recently, demodectic mange of cattle now appears to be prevalent in some areas at least, and is taking its toll. The tiny mites that cause the disorder work within the skin itself. Although the cattle themselves seem little affected, damage to the hide may be extensive and result in serious losses to the leather industry. Dr. Smith discusses the problem in this issue but indicates that it still awaits a solution.

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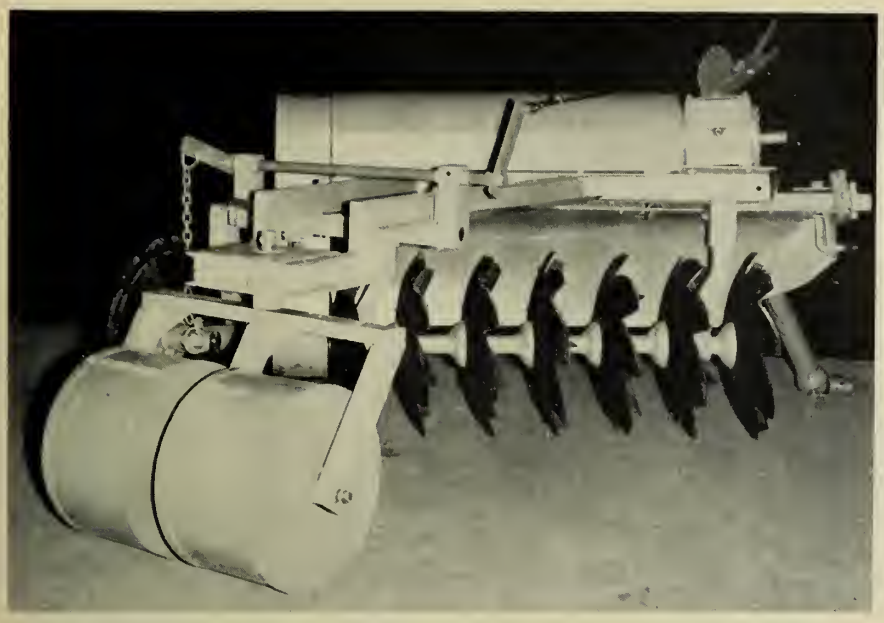
Cover Photo: **On June 3, 1961, Agriculture Minister Alvin Hamilton "fired" last tuberculin shot to wind up 38-year cattle testing program of Health of Animals Division. Event took place on farm of Joe Skirlik (right), Peace River district.**



Modified one-way disc will cut a strip of peat soil 42 inches wide by 6 inches deep and throw or move it laterally about four feet.

Land Crowning Machine

D. J. Cooper

AND

H. W. R. Chancey

ADEQUATE DRAINAGE is essential if peat soils are to be reclaimed for agricultural use. In preliminary tests at the Colinet Peat Substation in Newfoundland, we have developed a machine, consisting of a modified one-way disc designed to throw soil that will crown or center ridge the land in an attempt to provide adequate drainage with wider spacing of open ditches. We have found that wider spacing lowers drainage costs and, at the same time, permits more efficient use of mechanical equipment.

The method of land drainage now used on Newfoundland peat soils consists of open ditches spaced 50 feet apart which have been dug by a plow-type ditcher or a rotary ditching machine. Although this system provides a means of land drainage, it also presents a number of serious problems, among which are the construction and maintenance of long lines of ditches (approximately 880 feet per acre) and the difficulty in operating farm machinery on the narrow, 50-foot intervals between ditches.

Since standard soil moving equipment is ineffective on peat soils, we designed and developed a land crowning machine. Because of the fibrous nature of the surface peat layer, it was found necessary to throw or sling peat soil rather than scrape or plow it to accomplish the desired crowning effect. To perform this operation, we developed a one-way disc modified to throw soil to the side and rear of the machine. Power was supplied from the tractor power take-off through a gear box and drive shaft to a chain drive connected to the disc shaft. Angle iron slingers were attached to the concave side of non-clogging notched discs, 23 inches in diameter, driven at a speed of 180 r.p.m. To provide depth control and uniform cutting action, dual drum-type, non-directional trailing wheels were rear mounted. In operation, the machine will cut a strip of peat soil 42 inches wide by 6 inches deep and throw or move it laterally about four feet.

Under undrained conditions, Newfoundland peats have a water table fluctuating between 0″-6″ from the surface during most of the year. Only vehicles with special wide tracks can manoeuvre on the soft surface layer, while animals move with difficulty or become mired. Plant growth consists chiefly of sphagnum moss, gray moss, Juncus sedge and Carex sedge while the 0″-6″ surface layer consists of undecomposed and partly decomposed plants and root masses. This layer is porous and water movement is rapid but the soil below this section is a dense peat mass permitting only very slow drainage.

The purpose of land crowning or center ridging of lands (intervals between ditches) is to provide adequate drainage with wider spacing of open ditches. We are trying to determine how far apart ditches can be spaced with crowned lands. Treatments under this trial vary from 50 to 150 feet and height of crown ranges from 8 to 15 inches. This treatment of the soil surface, used successfully on mineral soil, is expected to lower the water level in peat soil by increasing the rate of water flow towards adjoining open ditches. Excess soil water accumulating in the more porous surface layer will drain off rapidly and in this way contribute to the lowering of the water level. Using the land crowning machine, a crown 12 inches high can be formed in three or four operations over the specific area.

Mr. Cooper is with the Agricultural Engineering Research Service, Ottawa; Mr. Chancey is Superintendent, Experimental Farm, St. John's West, Newfoundland.

Wild potato species resistant to late blight. *Left to right:* Solanum bulbocastanum, S. pinnatisectum, S. cardiophyllum, and S. trifidum.

Sources of Resistance to Potato Blight

K. M. Graham

BREEDING for resistance to late blight of potatoes was initiated at Fredericton, N.B. in 1936. The source of resistance at that time was the wild potato, *Solanum demissum,* collected from the highlands of Mexico. This material was used in crosses with desirable varieties of the domestic potato *S. tuberosum,* to produce two varieties of potatoes, Canso and Keswick, introduced to Canadian agriculture in 1951.

It has long been known that potato varieties differ considerably in their ability to tolerate blight infection. A few examples of highly susceptible varieties are Green Mountain, Katahdin and Bintje while many European varieties including Alpha, Voran, Noordeling and the American Sebago variety possess varying degrees of resistance in foilage and tubers. This type of resistance, believed to slow down the blight fungus in its rate of penetration and colonization of the plant and to reduce its crop of spores, is known as partial or field resistance and is apparently effective against all races. The resistance found in Canso and Keswick is characterized by a sharply defined necrotic host response at the site of penetration of the foliage by the fungus. This reaction to invasion is so violent that the fungus is either killed or completely prevented from spreading further and reproducing. This would be very desirable in a variety were it not for the ability of the blight fungus to produce types or races that are capable of attacking the varieties having this kind of resistance. Three years after Canso and Keswick were introduced a race appeared that was able to attack them.

Fortunately, the potato is just as highly variable as its archenemy, *Phytophthora infestans,* and has apparently been able to keep ahead of the disease for many centuries by virtue of its many genes for resistance. It seemed logical to undertake more extensive exploration for material bearing resistance genes in the area in which they had originally been found in *Solanum demissum.* Plant explorers have found sources of resistance in at least a dozen other species of wild potatoes in Central Mexico. Outstanding among these are *S. stoloniferum, S. verrucosum, S. bulbocastanum, S. cardiophyllum, S. trifidum* and *S. pinnatisectum.* The first two appear to be excellent sources of field resistance and selections of the latter four are completely resistant to our most highly specialized race of the blight fungus which is capable of attacking varieties with as many as 5 genes for resistance derived from *Solanum demissum.*

Typical blight lesion on a susceptible variety.

It is impossible to say that any given species of potato is uniformly blight resistant. The genetic diversity of all the species cited as sources is reflected thus: if 100 seedlings are tested from a field collection, a percentage of them may be as susceptible to a given race of *Phytophthora infestans* as any of our cultivated varieties, while the remainder may be completely resistant. Species apparently exist in their native habitat as populations of interbreeding individuals with varying numbers of

Dr. Graham is with the Research Station, Fredericton, N.B. where he specializes in major gene resistance re late blight of potatoes.

Left: **Flecking indicates a hypersensitive reaction.** *Right:* **Partial or generalized resistance.**

genes for resistance. Surveys of races of the blight fungus on the species *S. demissum* in Mexico have shown that they too exist as a complex of races, more or less in balance with array of resistance genes in the species.

Evaluation

The presence of races of the blight fungus complicates the task of selecting parental material. In this respect we have made it a point to collect as many cultures as possible of *Phytophthora infestans* from Canadian commercial potato fields and variety trial plots. This program, initiated in 1954, has provided us with some 20 races of the pathogen. Some races have been produced as probable mutants in continuous culture of the fungus on aging leaves of resistant seedlings. These new races are of great value in screening sources of resistance, because they represent fungus entities probably present in the field in a very low incidence. This procedure may enable us to stay ahead of the game for some time.

Although our Canadian race collection is as comprehensive as that of any potato-breeding establishment in the world, it cannot duplicate the complex that exists in the Valley of Toluca, 30 miles southwest of Mexico City. There, almost daily rains and 60°-70°F. temperatures during June to September ensure a yearly epidemic of late blight so severe that highly susceptible varieties do not survive beyond emergence of the sprouts. Seedling material from the Canadian breeding program was first tested for its field resistance there in 1956, and parents chosen from it have formed the basis of some of our most promising selections. Laboratory tests have so far shown a good correlation between resistance to our most highly specialized Canadian races of *P. infestans* and field resistance to the Mexican race complex.

Problems

The use of wild species in breeding for blight resistance is hindered by the presence of sterility barriers. Only *Solanum demissum* is easily crossable with commercial potato varieties. However, persistent research by the plant breeders at Fredericton has led to the discovery of ways to cross every one of the 6 species mentioned.

A possible drawback to the use of wild species is the fact that they may possess in addition to blight resistance, extreme susceptibility to one or more of the common potato diseases. For example, certain blight-resistant varieties, bred from *Solanum demissum,* possess high susceptibility to early blight and *Fusarium* dry rot. The species *S. bulbocastanum, S. cardiophyllum* and *S. trifidum* are extremely susceptible to virus X. However, thorough evaluation during the initial phases of selection of the hybrids between *S. tuberosum* and the wild species should prevent the introduction of deleterious genes. On the other hand, combined resistances are frequently encountered in wild species. Certain selections of *S. demissum* and *S. stoloniferum* are not only resistant to late blight, but also to wart, while immunity to virus Y has been found in *S. stoloniferum.* Apparently a given species may be heterozygous for resistance to a number of diseases as well as late blight. Therefore, the task of thorough evaluation of the disease resistance of parental material is of great importance.

Left: **Field-resistant selection.** *Right:* **Field-susceptible variety.**

Germ Plasm Bank

The Mexican wild species form essentially a germ plasm bank which should provide potato breeders with genes for blight resistance for many years to come. The combination of resistance genes from *S. demissum* with those from *S. verrucosum, S. stoloniferum, S. bulbocastanum* and the other species mentioned would broaden the genetic basis for resistance, and thus reduce the chance for the appearance of a race of *P. infestans* capable of attacking varieties incorporating this germ plasm. The way of introducing it into the breeding program is now cleared.

Author (above) examining canes of Chief variety.

Such varieties as Ottawa (above), Chief, Latham and Muskoka used as parents in crosses with other clones have given a high percentage of seedlings able to withstand low temperatures.

Sturdiness, Vigor, Hardiness Sought . . .

Red Raspberry Breeding

C. R. Ure.

RED RASPBERRY has a potential for much further improvement, and a consequent wider cultivation. The objective in red raspberry breeding at the Morden Experimental Farm is the production of sturdy, vigorous cultivars having a maximum of hardiness. Associated characteristics desired are maximum yield of fruit, large berry size, good appearance, firmness, superior flavor and quality. Future increases in production and utilization of this fruit will mainly depend upon the development of varieties with such attributes.

The successful culture of raspberry on the Prairies, and to some extent in all parts of Canada, is limited by the severity and fluctuations of fall, winter and spring temperatures. In some areas, protection over the winter season is provided by covering all or a portion of the canes, generally with soil. Although such a practice is usually successful, it adds greatly to the cost of production. The ultimate objective in raspberry breeding is the production of varieties with sufficient inherent hardiness to survive the winters without covering. At Morden, two approaches are under investigation. First, selected plants of the native American red raspberry are used as the source of hardiness to hybridize with large-fruited parents. Secondly, selections are made from hybrid populations involving the commercial varieties now available.

The author is Head of the Fruit Crops Section, Experimental Farm, Morden, Man.

Seedlings two generations removed from the wild parent revealed that superior hardiness is being retained but some difficulty is encountered in incorporating the necessary fruit size and quality desired in a commercial variety. Present indications suggest that a longer period of time will be required to combine the necessary hardiness with essential plant and fruit characteristics. At Morden we have made greater initial progress by the second procedure. The use of such varieties as Chief, Latham, Ottawa and Muskoka as parents in crosses with other clones has given a surprisingly high percentage of seedlings with ability to withstand low temperatures. The same studies reveal that certain specific crosses among the foregoing are more productive of hardy seedlings.

High yield of fruit is an essential attribute of a successful variety. All improvement programs recognize this character as it is exceedingly important to the producer. Analysis of recent data from raspberry breeding experiments indicate that fruit yields are correlated with plant vigor as measured by cane height or cane diameter. Hybrid progenies with generally tall canes usually possess a high degree of fruit production. It is apparent also that fruit yields are influenced more by specific crosses than by the general effect of any one variety as a parent. It becomes necessary then for the breeder to know what combination of varieties will give a high level of fruit production in the resulting progeny. There is further evidence that high yields and strong vigorous plants are produced in progenies from parents unrelated genetically. Since the raspberry is propagated vegetatively the initial level of production obtained in an F_1 seedling can be perpetuated. In local tests, *Boyne* has substantially out-yielded Chief and Latham, the two standard varieties on the Prairies.

Large fruit size holds high priority in the development of new varieties. Berries from such presently grown cultivars as Latham, Madawaska and Newburgh possess acceptable commercial size, while fruits of the hardier varieties such

as Chief, Honeyking, Starlight or Sylvan, which are better adapted to the Prairies, are considered too small. Coupled with large berry size, it is important to have a thick-walled fruit; that is, good depth of drupelet. Depth of flesh is partially associated with size and shape of plug or receptacle. Large, thick-walled fruits with small cavities have two advantages of interest to growers, wholesalers, and processors alike. Such berries weigh heavier per given volume, and are more resistant to crushing in harvesting, handling, shipping or processing.

Appearance and eye appeal are basic attributes of a commercially successful raspberry variety. Such factors as intensity, brightness and retention of color, and size and arrangement of drupelets contribute to the final attribute called appearance.

Color is especially important, whether the fruit be destined for the retail or processing trade. The retailer seeks a berry of medium to dark red color, bright and attractive, and one that retains these qualities; not one that darkens after a day or more in the display case or window. The processor desires a berry that carries sufficient red pigmentation of a stable character so that the canned or frozen product retains the required color and appearance. Varieties and seedlings differ widely in this regard. For example, we have found that Chief loses color when canned and becomes a pale, insipid red, while Madawaska produces a dark, bright red berry and juice. In evidence from genetical studies, there appears to be no barrier to combining in one variety a color acceptable both as a fresh or processed product. Also, much has yet to be learned about color retention. These are problems under study in the Morden raspberry improvement program.

Viking raspberry canes (top) grow tall; close-up of Viking (lower).

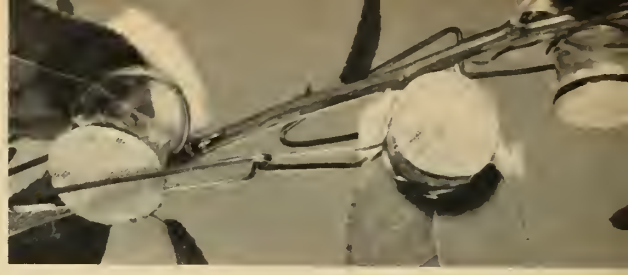
Brightness of color also markedly influences appearance and eye appeal. Unselected seedlings in hybrid populations bear fruits which vary from a very dull, drab skin surface to a glossy, bright surface. There appears to be no close genetic association between the degree of brightness and the intensity of red color. All combinations of the two characters are found.

Berry appearance, especially in the basket, is greatly influenced by drupelet size, number, arrangement, and manner in which the drupelets hold together. The objective is a berry with numerous drupelets of medium diameter and good depth, which are solidly held together. The final tests of eye appeal are made in the basket after harvest, because appearances are frequently very deceiving in the field. Many berries of first rate appearance on seedling plants crumble severely in handling. Some commercial varieties tend to crumble in certain seasons and under some environments. The factors responsible for crumbling or falling apart of the drupelets are not fully understood, although environment, genetic factors and disease are known to play a part.

Firmness of flesh should accompany a small cavity and thick-walled berries to ensure that a selection will be a good commercial variety. While chilling and proper handling of berries after picking are known to improve firmness, further improvement is possible through breeding. Experiments at Morden show that certain varieties as parents, and also certain specific crosses, are capable of transmitting firmness to a large proportion of their offspring. Ottawa, Taylor, Madawaska, and Muskoka as parents were among the best in passing on firmness of fruit to their progenies. Crosses of Ottawa with the other three mentioned, and with Lloyd George (a European variety) produced the highest proportion of firm fruits. A number of selections now under observation possess a firmness superior to varieties presently grown on the Prairies.

Superior flavor is equally essential to the retailer and processor to ensure continued sales. Quality is regarded as that combination of attributes which significantly determine the degree of acceptability of a product to the user. Since flavor is an inseparable component of, and one of the important constituents of quality, they are considered together. Flavor is a complex of several factors of which sweetness and acidity predominate. People differ considerably in what they consider to be good flavor depending upon their threshold of perception for sugars and acids and combinations of these two. Studies are carried on to sort out and measure those characteristics of the raspberry fruit which contribute to best flavor.

Choice of proper parents is the first consideration in a breeding program. In local experiments certain cultivars were superior as parents in the production of seedlings with a high level of fruit flavor and quality. Madawaska and Taylor have been two excellent parent varieties under Prairie conditions. Once again specific crosses, rather than a particular variety, have been of equal if not greater importance in the production of offspring with high quality fruits. Such parental combinations as Ottawa × Madawaska, Ottawa × Muskoka, and Madawaska × Muskoka, have given a high percentage of seedlings with good quality fruits. *Boyne,* a recent Morden introduction, has rated superior to the standard varieties, Chief and Latham, in fruit quality determinations.



Sugar-beet root aphids (left), infected with fungus disease *Entomophthora aphidis*, move from roots to upper parts of beet plant. *Lower:* Aphids feeding on secondary roots of beets. *Upper:* Cages used to study migration of aphids from poplar galls.

Sugar-Beet Aphid

A. M. Harper

THE sugar-beet root aphid is a native of Western Canada. The insect originally spent part of its life cycle on native poplar trees and the remainder on the roots of lamb's-quarters or other native hosts. With the introduction of sugar beets into the regions where the aphid occurred, the insect included beets among its summer hosts and thus has become of considerable economic importance.

The sugar-beet root aphid was first reported on sugar beets in Alberta by H. L. Seamans in 1929, but the aphid did not become a serious pest until 1949. In 1950 a research project was initiated at the Lethbridge Research Station on the biology and control of this aphid.

Damage, Predators, Disease

The sugar-beet root aphid sucks the sap from the roots of beets and can destroy most of the rootlets and severely damage the tap root. A few aphids will not appreciably change the appearance of the beets, but a large population will cause the plants to wilt and, if enough sap is removed, the beets will die. As populations increase rapidly, fairly severe damage may be done before the aphids are noticed. In studies using the constant-temperature-soil tanks at the Lethbridge Research Station we found that at 77°F. 20 sugar-beet root aphids placed on the root of a single beet increased to a population of over 9,000 in six weeks.

Dr. Harper is a specialist in sugar-beet insects at the Research Station, Lethbridge, Alta.

In southern Alberta we have found that the sugar-beet root aphid and related gall aphids may be destroyed in the galls on poplar trees by the small bug, *Anthocoris antevolens* White, the larvae of the syrphid fly, *Syrphus bigelowi* Curran, the larvae of a small grey fly, *Leucopis pemphigae* Mall., and a coccinellid beetle of the genus *Scymnus*.

On the roots of the sugar beets the aphid is controlled mainly by the larvae of the small black and yellow fly, *Thaumatomyia glabra* Meig. This predator has been found in all fields infested with root aphids. In some heavily infested fields there is an average of over 150 larvae or pupae of the predator around each beet.

In certain years a fungus disease caused by *Entomophthora aphidis* Hoffm. completely destroys all aphids in some fields but in other years the incidence of the disease is negligible. It is interesting to note that the disease causes the infected aphids to leave the roots of the beet plant and climb onto the crowns and leaves. Many of the aphids, even after death, remain clinging to the leaves. This clinging reaction is similar to that of grasshoppers infected with a closely related disease.

Chemical and Cultural Control

At present there is no satisfactory chemical control for the sugar-beet root aphid. In spring it would probably be difficult to control them with chemicals as the aphids are protected in the galls. Furthermore, infested poplars are found mainly along river banks

LIFE CYCLE

The life cycle of this insect is complex. At the time that the leaves of the poplar open in spring a wingless aphid known as the stem mother hatches from the overwintering egg. This aphid feeds on the opening leaf, causing a gall to form at the point of feeding. In the gall the aphid gives birth to from 75 to 150 young, which have wings when fully developed. Between late June and early August these winged forms fly or are blown in all directions. Many land on beets where they produce the wingless summer forms that cause damage to the sugar beets. There are several generations on the summer host each year.

In late summer and early fall the wingless aphids on the beets produce large numbers of winged forms, which fly back to the poplars. In protected places on the bark they give birth to several small, yellow, wingless aphids that are either male or female. After mating, each female deposits a single white egg in a crevice in the bark of a poplar tree or under the bark of a dead branch, where it remains for the winter. It is only in fall that males are produced. Throughout the rest of the life cycle there are only females. These all give birth to live young without mating.

The summer forms do not all produce winged migrants in fall; a small number continue to produce wingless forms. These overwinter in the soil in beet fields or on lamb's-quarters in ditches and headlands and can become established on beets in spring.

Tanks used to study influence of soil temperature on the sugar-beet aphid.

that are not readily accessible. Applications of insecticides to beets when the aphids are migrating may be practical but would probably destroy many of the predators flying at that time. In the laboratory we found that systemic insecticides did not control the sugar-beet root aphid, although they did control leaf aphids present on the same plant. Several soil insecticides showed promise in the laboratory. In the field, however, they destroyed predators and in the fall the population of aphids was generally larger in the treated than in the untreated plots. The untreated plots had an average of four to five times as many predators as the treated plots.

Galls caused by aphids on poplar trees in Alberta. Gall in upper left is that of sugar-beet aphid.

At present the most satisfactory method of reducing root aphid damage in southern Alberta is to keep the soil fertility high and to irrigate the beets early and frequently to permit rapid, vigorous growth throughout the season. Farmers who have followed this practice have generally obtained average or above-average yields.

Other Poplar Gall Aphids Important

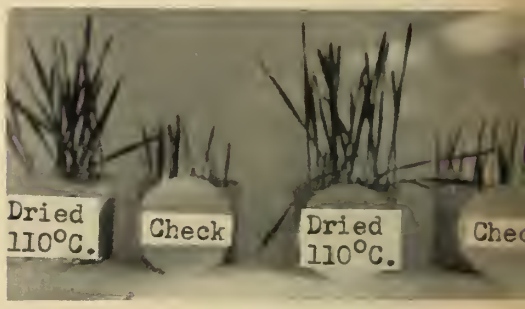
During the course of these studies at the Lethbridge Research Station we found that eight other species of aphids also caused galls on poplars in southern Alberta. Information was obtained on distribution, migration, reproductive capacity, gall formation, and biological control of these aphids.

The poplar gall aphids have become important in several countries, not because they cause galls on poplar but because they live part of the year on the roots of a secondary host, which they damage. Species of poplar gall aphids have damaged carrots in Holland, cabbage in Texas, beets in Germany, Canada, and U.S.A., and lettuce in England and California.

At present the secondary hosts of some of the species studied in Alberta are not known. However, with the expansion of irrigated areas in southern Alberta additional crops are being introduced and some may become secondary hosts for poplar gall aphids.

Left: Effect of odded sodium nitrote on plant growth of three Solenetzic soils. Treated (left), untreated (right). Note difference in productivity of untreoted soils (white material is exploded rock placed over soil surface to prevent crusting).

Below: Effect of heot drying on productivity of surface samples of Solonetz soil. Left to right—heated, not heoted, heoted, not heoted.



Probing Solonetzic Soils

Search is on to find a way to speed up the natural release of nitrogen and the most economical method of applying it

R. R. Cairns

SOLONETZIC SOILS cover more than 15 million acres in Western Canada. Almost 10 million acres occur in Alberta and the remainder in Saskatchewan and Manitoba. They occur mainly in the Black, Dark Brown and Brown Soil Zones. That they present serious production problems because of their physical characteristics has been known for some time, but it has now been established that a serious nutritional problem is also involved.

Solonetzic soils may be recognized by the great variability in crop growth that causes a patchiness in the appearance of the crop. Areas under fallow may be very misleading to the inexperienced, for the dry soil may be black and powdery and look as if it ought to be fertile. It is only after heavy rain or irrigation when water is held on the soil surface because of their impermeable nature, that these soils betray how intractable they are. In some areas however the surface is covered with shallow depressions, known as slick spots or burnouts. It is only by digging that they may be clearly recognized and the seriousness of their condition assessed.

There are four main Solonetzic conditions, termed Alkali Solonetz, Solonetz, Solodized-Solonetz, and Solod. They often occur in association with even less productive Saline soil and the more productive normal soil. The least productive member is the Alkali Solonetz and the most productive, the Solod, with the others falling between. Identification is based on the condition of the B horizon. Soils, during their development, become layered. The surface layer (A horizon) of reasonably mellow soil may vary in depth from a few inches to over a foot. A whitish layer may or may not occur immediately beneath it although such a layer usually occurs in the more productive soils. However, the massive B horizon, in which clay has accumulated, is the one by which Solonetzic soils are identified. It can be easily recognized because of the great difficulty in digging through it. It will be encountered within six inches of the surface on the less productive soils and at a depth of a foot or so in the more productive ones. In all cases this horizon of a Solonetzic soil breaks into vertical columns, whereas that of a normal soil breaks into crumbs. If the columns are massive and flat-topped and occur within a few inches of the surface, the soil is either Solonetz or Alkali Solonetz. If the columns occur a little deeper or have distinctly rounded tops, the soil is Solodized-Solonetz. If the columns occur at considerable depth and are fairly mellow, the soil is a Solod. The Solod does not present nearly as serious a production problem as the other members.

All Solonetzic soils have been influenced by sodium or magnesium salts during their development. The influence of these salts determines the nature of the B horizon and it, in turn, creates the poor physical property because of its impermeability to water and resistance to root penetration. During the early stages of the development of Solonetzic soils a massive B horizon is formed which, on further development, tends to disintegrate at the top giving rounded columns. In later development the

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clay columns further disintegrate and move deeper in the profile.

With this limited outline of the features and method of development of Solonetzic soils, it is easy to understand that their physical characteristics limit productivity. This factor has long been recognized and much work has been done in Russia and Hungary to alleviate the problem. All of such work has centered on applying calcium in the form of gypsum, or elevating the native gypsum by plowing to a 24-inch depth. The calcium counteracts the destructive effect of sodium on soil structure. In greenhouse, laboratory, and field studies at Vegreville and on soils throughout Central Alberta, we found that the amount of gypsum required was too great to be economical under present conditions and that mixing the surface and subsurface layers was only effective for a few isolated soils. We also discovered that the yellowing so commonly encountered in field crops on these soils and invariably attributed to the effect of the B horizon on moisture relations occurred in plants grown in the greenhouse on topsoil under any moisture conditions. Further study revealed that mixing the salt and surface soil layers overcame this crop yellowing and that added sodium sulphate had the same effect. However, the alleviation of the symptoms did not always result in growth increase. Sodium sulphate does not have any known beneficial effect on the physical condition of soil and, thus, the response had to be attributed to a nutritional effect.

Solonetzic soils are quite often high in organic matter and nitrogen; indeed, the least productive soil contains about ten per cent of organic matter. For this reason, little attention had been paid to their response to nitrogen. However, in the greenhouse, we found that the addition of nitrates, besides overcoming the crop yellowing, resulted in great increases in crop growth on all soils. Indeed, the provision of nitrogen allowed for the production of several crops in rapid succession without the development of a deficiency in any other nutrient. Further laboratory study revealed that the greenhouse productivity of these soils was closely related to their ability to release nitrogen in a form available to plants.

On the basis of these results we conducted several field experiments. One established in the fall of 1959 at Vegreville will illustrate the results. Eight hundred pounds of 11-48-0 and 1,920 pounds of 16-20-0 were applied in strips on an established brome sod on July 26 after harvest. These treatments provided an equal application of phosphorus. Samples were harvested on September 9. Where no fertilizer was applied the yield was 482 pounds of dry matter per acre; the strip treated with 11-48-0 produced 866 pounds, and that treated with 16-20-0, 1,215 pounds. Since the phosphorus application was equal, it is apparent that the degree of response was related to the nitrogen supply. Added nitrogen provided for almost a tripling of the growth during a one-month period.

It seems unreasonable that nitrogen should be a factor limiting production on a soil well provided with organic matter. We are now trying to find a way to speed up the natural release of nitrogen and the most economical method of applying it. A means of speeding up the natural organic matter turnover should be the most desirable solution to the problem. Until some other method is found to stimulate the release of nitrogen, time-honored good farming practices will be of great importance on these soils. Good fallow practices and seed-bed preparation stimulate nitrogen release, and the judicious use of fertilizer can help overcome the deficiency.

Soil Research Substation, Vegreville, Alta.

Virus-infected chokecherries and other native shrubs on the hillside above the orchards in the southern Okanagan Valley, B.C.

Ring Pox of Apricot and Twisted Leaf of Sweet Cherry . . .

Pose Mystery for Okanagan Virus Experts

T. B. Lott

AND

F. W. L. Keane

HEALTHY-LOOKING wild chokecherries are carrying enough virus to spoil the sweet cherry and apricot crops of the sunny Okanagan Valley of British Columbia. This situation has just become known but the virus was probably there before the first commercial trees were planted. It is a mystery how most of the orchard trees can stay healthy when there is plenty of virus close by in a common native plant like the chokecherry.

Research work on virus diseases of tree fruits is a slow business. This story goes back about twenty years, to a time when little was known about any of these diseases and when many of them were unknown.

Twisted leaf of sweet cherry was studied first at Summerland, though it appeared a little earlier in the State of Washington. Ring pox of apricot was discovered and studied in Colorado, and soon afterwards in the Okanagan Valley.

The authors are specialists in fruit tree virus diseases at the Research Station, Summerland, B.C.

Twisted leaf seemed to be a very serious disease in just a few Bing cherry trees. Nothing like it had been reported anywhere else. Then it was determined that the disease could be transmitted artificially from a diseased tree to healthy ones, and its virus nature became established.

Ring pox was discovered in apricot in the Okanagan Valley just after the disease had been reported as a virus type. Small experiments showed that our disease was transmissible to healthy apricot trees and was actually the ring pox disease reported in Colorado. Then for some years less attention was paid because ring pox was only rarely found in commercial orchards.

Experimental work was expanded, especially in 1949 in plantings in the Station's new isolation orchard. Twisted leaf virus was obtained in living tissue from four naturally infected cherry trees. It was inoculated, by budding, into fifteen varieties of sweet cherry, into several other species of *Prunus,* including sour cherry, peach, prune, apricot, and the chokecherry which is common in the Okanagan and Similkameen Valleys and north up into the Cariboo. Apple and pear trees were also inoculated.

All the varieties of sweet cherry became infected. That is, the virus became established in the treated trees. However, the damage done by the virus, as indicated by the visible effect, depended on the variety of the tree. Van trees were damaged very severely, while Sam trees carried the virus but showed practically no damage. Other varieties were intermediate.

We found that the twisted leaf virus could not maintain itself in apple, or pear, or prune. It could multiply in peach, and sour cherry, and mahaleb rootstock but no effects were visible.

New Experiments

Two results led to new lines of experimental work. Apricot trees, inoculated with the twisted leaf virus from sweet cherry, developed ring pox which had previously been thought of as a separate disease. We also discovered that chokecherry trees could be infected with the twisted leaf virus but remained apparently healthy. Thus it appeared that the cherry disease and the apricot disease might be caused by the same virus instead of two quite different viruses, and the chokecherry was indicated as a symptomless wild host.

When we inoculated apricots with twisted leaf virus, ring pox developed three times out of four. This was more ring pox than would be expected if the virus that causes ring pox was only present as a chance contaminant. It also indicated that the virus of ring pox could be maintained in

Twisted leaf, a virus disease of sweet cherry.

Ring pox, a virus disease of apricot.

sweet cherry. Inoculations from some of the diseased apricots back into cherry produced twisted leaf and proved that apricot is a host of the twisted leaf virus.

Then we collected material from 43 twisted-leaf-infected, cherry trees in different parts of the Okanagan and Similkameen Valleys and inoculated it into apricot. We found the virus of ring pox in 30 of the 43 diseased cherry trees. On the other hand, when material from 18 apparently healthy cherry trees was inoculated into apricot, no ring pox occurred.

In reciprocal experiments, we inoculated material from 32 apricot trees with ring pox into cherry. In 26 of the 32 diseased apricot trees we found the virus of twisted leaf present. On the other hand, when material from 237 apparently healthy apricot trees was inoculated into cherry, twisted leaf virus showed up in only two of the apricot trees.

Still Some Uncertainty

In experimental work a few attempted transmissions do fail. Disease expression is sometimes indefinite or may be delayed until the second or even the third year. We are not yet certain that twisted leaf in cherry and ring pox in apricot are caused by a single virus, but this appears to be a probability. This is also suggested by the way the two diseases have been occurring in the same orchards and spreading at about the same rate, and by work with the wild host.

The discovery that chokecherry was a host of the twisted leaf virus gave a hint that perhaps wild chokecherries were the reservoir from which this virus was spreading into the orchards. We collected material from chokecherry trees growing near diseased orchard trees and inoculated it into sweet cherry and apricot. Our results showed that twisted leaf and ring pox could both be produced by such inoculations, and therefore that some wild chokecherries were infected. But they did not tell whether the virus was going into the orchard trees from the wild ones or the other way round. We also found that both diseases were obtained out of some groups of chokecherries, but neither disease out of other groups.

Chokecherries are quite common in the Okanagan and Similkameen Valleys. Some are so small that they almost disappear in the grass while others are fair-sized trees. Quite often they form dense thickets. In an attempt to sample native chokecherries far away from orchard trees, we collected material from groups of such trees in and around both valleys. Inoculations were made into cherry. Our results disclosed that the twisted leaf virus is both indigenous and generally present. We demonstrated that the virus was present in 34 out of 49 locations. It was also present in 16 places at least a mile from the nearest orchard and in another 19 miles away. In addition we located the virus 1,900 feet above the nearest orchard. Furthermore, we found twisted leaf virus present in wild chokecherry in 21 locations at least 2 miles from the nearest known twisted leaf, and once at a distance of 25 miles.

Presence of the virus in a wild plant may explain the sudden appearance of twisted leaf disease in orchard trees where no source of infection has been apparent. There is almost a certainty that similar new appearances of ring pox in apricot can be similarly explained, though experimental work with ring pox is less advanced.

It is physically impossible to remove all the chokecherries. There are too many and they are difficult to eradicate except perhaps with brush killer. While the two diseases do not at present warrant any general alarm, they have caused serious damage in some orchards and are spreading slowly. It is believed that the virus is spread by some insect, possibly a leaf hopper. The danger caused by the chokecherries depends on their quantity, size, and proximity to the orchard trees. The present recommendation is to remove chokecherries as much as possible from the vicinity of apricots and sweet cherries. It is not yet possible to suggest any specific distance. There is also the recommendation to remove diseased orchard trees.

Portable plastic silos are taped around the circumference as gas formation subsides, to minimize wind damage.

Portable Silos - Grass Storage for Cattle

What Preliminary Investigations Reveal

V. S. Logan

TRIALS at Ottawa with 'portable silos' show promise that the use of plastic sheeting can provide a means of storing grass for silage when permanent silage space is inadequate. We have found, in preliminary investigations, that a greater nutrient value of the grass crop can be preserved under adverse weather conditions using a portable silo than by the field drying process.

The so-called 'portable silo' consists of a plastic sleeve open at both ends and varying in diameter and length to provide capacities up to 80 or more tons of stored silage. The plastic sleeve provides a covering for a silage stack which is constructed by filling a snow fence arranged in a circle 16 feet or more in diameter, depending on the capacity required. At the start of the operation, the plastic sleeve is rolled and placed around the circumference of the snow fence so that approximately three feet of one end of the sleeve extends inwards under the fence. This makes an effective seal at the lower portion of the stack. The fence is progressively raised and reduced in diameter as three or four tiers are filled to complete the stack. The plastic sleeve is then unrolled up the sides of the stack, gathered and tied at the top.

In experiments at the Animal Research Institute, Ottawa, we are trying to determine the suitability of portable plastic silos as an economic means of conserving the nutritive value of grass where permanent silo space is inadequate for complete requirements of the cattle maintained. Such factors as fermentation losses (gases, liquids) and surface spoilage of grasses stored in these silos are measured. Lactating dairy cows are used to determine effects of type of silage on milk yields, milk composition, body weight change and digestibility.

Nutritional Value

The silages were fed as the sole roughage to cows in early lactation. Data for this phase of the project are not yet complete. Preliminary observations indicate that all silages were readily eaten, consumption reaching as high as 120 pounds per head daily. The moisture content of the silages had a definite effect on milk yields but changes in body weight were not significantly affected. We measured the water intake of the cows and found a definite trend in that they consumed less water while on rations containing silage of higher moisture content. The ratios were not directly proportional in supplying the animals' water requirements. The effects on other factors such as energy intake, nitrogen retention, milk composition, etc., with respect to the silages fed and in relation to hay, are still under study.

Grass from the same field was stored in three plastic silos during each of two seasons. To determine the effect of moisture content on

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Severe winter conditions will damage plastic. By removing plastic coverings at beginning of winter feeding, they can be preserved for several years' use.

Demodectic nodules on the brisket, axilla and adjacent areas of a Guernsey cow.

Bovine Demodicidosis

(Demodectic Mange)

Cause of Extensive Damage in Leather

H. J. Smith

BOVINE DEMODICIDOSIS is an infestation of cattle with the small, cigar-shaped mange mite, *Demodex bovis*. All stages of its life-cycle—egg, larva, nymph and adult—are found within the skin of its host. Until recently, bovine demodicidosis was infrequently reported in Canada and consequently aroused little more than academic interest. However, a two-year study carried out during 1958 and 1959 has shown that this disease is prevalent in cattle in southern Ontario.

In this investigation, the incidence of demodicidosis was determined both in cattle and in hides. Its presence was demonstrated in 40.8 per cent of the 828 cattle examined. All common breeds of cattle—Holsteins, Ayrshires, Guernseys, Jerseys, Aberdeen Angus, Herefords and Shorthorns—were studied and found to be infected. The incidence recorded in the first five breeds mentioned was 41 per cent or greater, while only 19.6 per cent of the Shorthorn and 21.5 per cent of the Hereford cattle studied were shown to have the disease.

In cattle two years of age and older, the incidence of the disease was relatively constant, ranging from 41.6 to 53.8 per cent within the various age groupings. Among calves and yearlings, 15.4 and 28.8 per cent, respectively, were found to be infected. In very young calves, the disease was not recorded; the youngest calf observed to have the condition was a five and a half month old Jersey. The low proportion of young animals with demodicidosis was attributed to the slow transmission and develpment of the disease.

The incidence observed in 2,142 hides selected at random in a tannery was 24.1 per cent, which was somewhat lower than that observed in cattle. A probable explanation is that dairy cattle two years of age and older predominated in the field survey, while many of the hides examined were from beef animals in the one to two year old age grouping.

In the cattle studied, demodicidosis did not noticeably affect the general health; the only symptoms noted were associated with the skin lesions. It should be pointed out, however, that systemic symptoms, such as extreme puritis (itching), emaciation and even death, are often associated with the disease in Madagascar and Africa.

The characteristic lesions of demodicidosis are nodules lying within the skin. In some animals small scab or crust-like lesions also are associated with the disease and are usually observed on the shoulders and withers. Nodules, on the other hand, may be found on any part of the body but are more frequently found on the axillae (armpit in the human), neck, shoulders, withers and adjacent areas. The number of nodules per animal may vary from two or three widely dispersed nodules to a hundred or more in generalized cases. They vary in size from that of a grain of sand to that of a pea or larger. Many nodules lie within the skin but may be felt or palpated, especially if the skin is loose enough to roll between the fingers.

In cattle that are clipped or have short, sleek coats, demodectic nodules are readily seen by direct examination. Such examinations are best performed in sunlight. However, a more effective way to detect demodicidosis is to run the hand over the body of the animal to locate the presence of nodules.

Although demodectic nodules are palpated in the skin of the animal, they are best demonstrated in lime-sulphide treated hides from which the hair, flesh, fat and fascia have been removed. The nodules appear as small, dark spots when light is transmitted through the hide from the flesh surface and examination is made on the grain surface. This technique enables counting of all nodules, even though they may be minute and lying within the thickness of the hide.

Close examination of the grain surface of limed, unhaired hides often reveals small openings which are associated with nodules lying within the hide. In finished leather, these small openings appear as small defects and give rise to the

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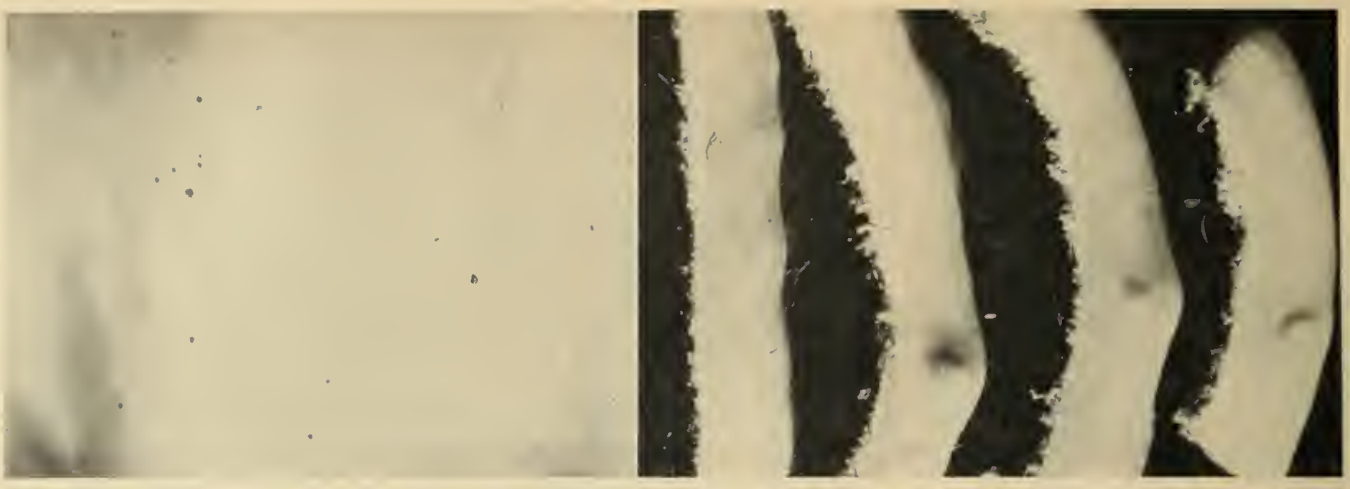

Left: **Finished leather showing large, ragged defects and voids caused by the presence of large demodectic nodules in the hide.** *Right:* **Cross sections of limed, unhaired hide showing appearance and the location of nodules.**

term "pinhole damage". To determine the presence of this damage, the leather is examined under oblique lighting.

Larger nodules involve a greater part of the thickness of the hide and in leather the areas occupied by these nodules are ragged defects or areas of weakness. In split leather, the areas of the hide occupied by nodules often leave voids.

The degree of damage to hides depends to some extent upon the number and the size of the lesions. Such damage, unless negligible, results in a down-grading of the leather and in heavy losses to the leather industry. Severely damaged leather is of little value and may be a complete loss. Thus, demodicidosis is of great economic importance to the leather industry, but of little concern to livestock breeders as few symptoms are observed in living cattle. Unfortunately, as yet, a specific effective treatment against bovine demodicidosis is not available, although it has been reported that the usual cattle scab dips and sprays appear to slow progress of the disease.

At the moment much remains to be learned concerning bovine demodicidosis and further research, particularly on the transmission, spread and bionomics of the parasite, is prerequisite to successful control and treatment of the disease.

PORTABLE SILOS—Grass Storage for Cattle . . . *from page 14*

feeding quality, the grass was harvested at three dry matter levels (22, 28 and 35 per cent) in the respective silos each season. These levels represented direct cutting and loading after heavy dew or rain, direct loading of grass cut when dry, and grass wilted approximately five hours. Each silo contained nearly 25 tons of green material.

During the first 24 hours after the silos had been filled, the plastic coverings ballooned because of gases from the fermentation process indicating all silos were reasonably gas-tight initially. Subsequently, punctures resulting from wind or other cause necessitated some patching of the plastic coverings.

Spoilage Rates

Silage of intermediate moisture content (28 per cent dry matter), showed the least spoilage the losses being two per cent from fermentation, and five per cent from spoilage. The silage of high moisture content (22 per cent D.M.) had a spoilage loss of 40 per cent, partly due to insufficient quantities being fed out each day. Silage of low moisture content (35 per cent D.M.), with a spoilage loss of 65 per cent, was the poorest of the three silages. Inadequate packing of the drier material seemed to account for this, since pockets of spoiled silage occurred throughout the silo stack. Fermentation losses were similar for each type of silage.

During the first winter, the plastic covering was rolled down each day as the silage was removed from the stack and closed over to protect the material from seepage caused by heavy snow or rain. During severe weather (−20°F.) the plastic cracked and perforated, becoming unserviceable for further use. To overcome this difficulty and preserve the plastic sleeves for several years' use, the procedure followed the second season was to sacrifice the portion of the sleeve end (2½ to 3 feet) under the stack by cutting the plastic around the perimeter of the base which permitted removal of the sleeve intact for storage. Subsequently, the tops of the silo stacks were protected by tarpaulins or other coverings. By this procedure the plastic sleeves could be used for at least three years.

Frost penetrated a considerable distance into the silos, the heavier freezing occurring with the silage of higher moisture content.

The plastic sleeves of 6 mill (6/1000 inches) used for this project will readily tear or puncture unless carefully handled. A tougher, more durable material consisting of terylene netting imbedded in polyvinyl or plastic sheeting is now being manufactured. A further development is the use of a vacuum pump or other means (tractor manifold) to withdraw the air from the grass mass when the plastic silo is completed and sealed. This results in collapse of the grass stems and compaction of forage to a much greater extent than would be achieved by ordinary tramping.